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TRONDHJEM: A SUB-ARCTIC PHENOMENON

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There is a town, well up the Norwegian coast, which the Norwegians will tell you ranks as their third city. Oslo, the country's capital, has a population of 253,000; Bergen, on the lower west coast, 98,000; and Trondhjem,* in spite of remoteness, inhospitable latitude, and encircling mountains, records in the 1930 census 54,000 inhabitants.

Americans addicted to cruises know Trondhjem as one of the periodic stops affording brief leg-stretching opportunities. There is a nice little cathedral; stone piled upon stone in a town otherwise built of wood. There are several blocks of good-looking shop windows very like such windows in an American town of the same size. There is a royal "palace" of vertical boards with wood-battened joints which with difficulty can be distinguished from the nearby apothecary's house. There are post-cards; "souvenir" ash trays bearing the word "Trondhjem"; a recent monument which successfully avoids the scurrying throng; a row—two rows—of wooden warehouses five or six stories high ("a heck of a long way to come to look at some warehouses!") and—there is a meal waiting on the boat.

A gentle little city, so remote from Norway's major populations that few Norwegians ever see it. A self-reliant, intensely neat, and eminently respectable little city, where everyone knows everyone else and the long winter evenings are enlivened by cheerful "parties" in the homes, or suppers in the churches, rather than by more

*Trondheim is the spelling approved by our Geographic Board. Other forms have been Nidaros, and Trondhjem. I use the spelling Trondhjem because it follows the tendency in Norway today. "Heim" is the Germanic, "hjem" the Norwegian, form of "home." Trondhjem is the ancient capital, or "throne-home" of Norway; the kings still go there from Oslo for their coronation, as French kings went to Rheims.

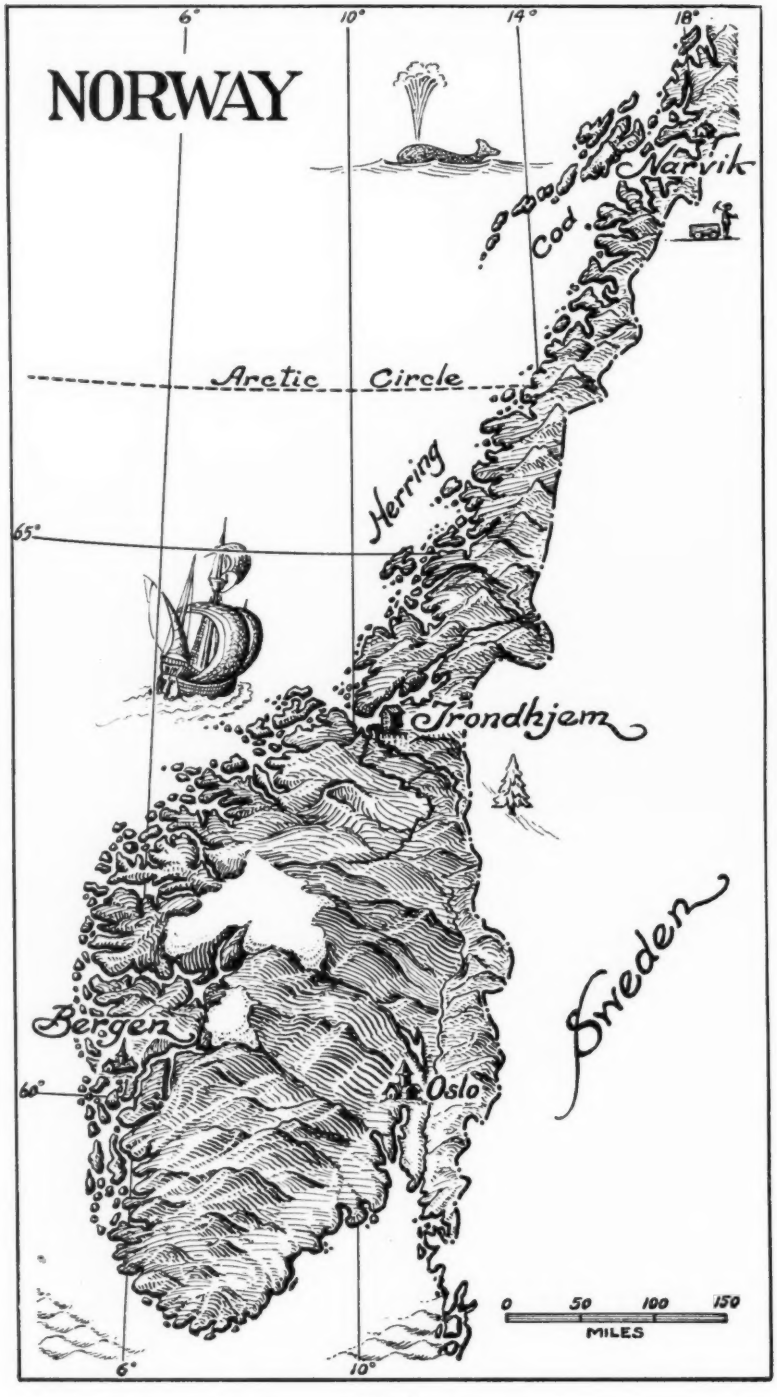
NORWAY
6°
10°
14°
18°
Narvik
Cod
Arctic Circle
Herring
65°
Trondhjem
Sweden
Bergen
Oslo
60°
0 50 100 150
MILES
6°
10°

Fig. 1

pretentious and calculating sophistications in a hotel ballroom.

A little fishing town which has become a shipping center. A farm village which has become an international *entrepôt*. A northern outpost of civilization which is a metropolis! Until I visited Trondhjem it had never occurred to me that a metropolis might be so tiny a thing. Having seen the town and the country roundabout—several

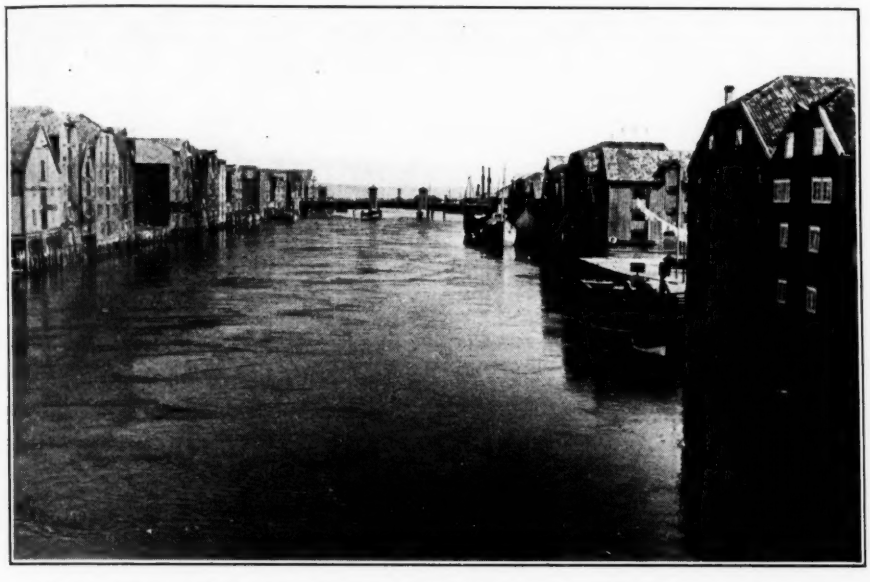

Fig. 2. The original river harbor of Trondhjem and a few of the warehouses.

hundred miles roundabout—I can think of no great city which is so pure an example of the economic and social center we call a metropolis.

I shan't bother you with the latitude of Trondhjem, the most northern industrial city in the world. But if the town were slid due west until directly north of New York City, say, it would find itself in the middle of Hudson Strait, just 1600 miles north of Grant's Tomb and some fifty miles north of the entire eastern part of the North American continent. Perhaps, since we think of Labrador as being bleakly northern, it would be more effective to say that Trondhjem would be 210 miles north of the northern tip of Labrador!

It is a thriving city to a startling degree. Its shops are more varied, extensive, and richly stocked than those of an English town of twice the size. Banks are numerous and housed in buildings with

wide façades; within, dozens of men working, queues of clients. One familiar with the somnolence of most European banks outside the capitals can scarcely believe his eyes. There is a whole street of the elegant establishments of importing, exporting, and brokerage firms. There are hotels in which every room has a bath; an orchestra plays discreetly during the dinner hour; uniformed bell-hops are trim and alert instead of slovenly, and the *maître d'hôtel, cap-à-pé,* suggests *ris de veau aux champignons, vin blanc,* as unemotionally as tho he were offering the eternal boiled cod and potatoes of north countries.

In every little Norwegian fishing village there is a warehouse on the dock, as there is in the larger port towns of New England. In Trondhjem one might expect the warehouse to have expanded into three or four—or even six—in ratio to the town's size. But there are dozens of huge warehouses; over a hundred of them, in fact; with trucks backed up to their platforms on one side and sloops tied up on the other; ropes and pulleys busy with boxes, barrels, and bales, and surpluses of furniture or machinery or boat chandlery being bustled about on the pavements. There is a large slaughterhouse on the principal wharf thru whose doors one sees a long line of carcasses marching slowly in procession beneath a moving belt. The ice-plant, next door, with its crushers, conveyors, and trucks, would be a credit to the Fulton Market wharf in New York, or the Fish Pier in Boston.

And everywhere, well-dressed, active, educated people; intelligent service in the stores; swiftness where one might expect lethargy; sophistication and elegance where, in many another shipping town of this size, one would condone, however reluctantly, smells, dirt, and dinginess.

Unless there is a cruise-boat landing tourists, the shipping is made up of smaller fry, but there are dozens of ships along the quays of the estuary, which was the original harbor; the slips which were added later; the great ramifying piers that are quite new; the shores of the open bay; or at anchor, awaiting their turn. On the face of things Trondhjem has gone mad; its activity, economic sophistication, and top-heavy maritime development seem wholly out of scale, not only with its environment, but with its size and apparent function.

To a visitor arriving by boat, the answer would be, a rich and extensive hinterland. But one who had reached the place by way

of the bleak miles of snow and tundra-covered fjeld which rises as a mountain barrier only a few miles back of the town, could harbor no such illusion.

Trondhjem is a metropolis *par excellence* because of two things: (1) Its location in relation to the area it serves is incomparable and brooks no rival—a condition rare among metropolises. (2) The very limitations of its northern environment have acted as a spur, urging the development of every negligible resource which in a richer land would be overlooked. *Multum ex parvo* might well be its slogan.

The map tells most of the story of location. The town is situated on a deep, wide fjord which from bank to bank is a safe channel for the largest ships; far enough inland both for protection and to center the radiating valleys whose outlet the fjord is; on the mouth of a stream wide and deep enough to afford a snug harbor for small coasting vessels, and just down-stream from the river's last plunge from the upland. Here was the grist-mill's site in early days; today the whole fall is harnessed to give Trondhjem an abundance of electric power.

That which does not appear on the map is the nature of the soil. A rich delta spread out by the stream offered such an area of arable land as is rare in this country of glacier-scraped rock, and made the town a farm center centuries before there were dreams of overseas trade or any secondary activity but fishing.

This same river opened, too, a route to the widened valley to the south on whose sandy, glacial clays, sheltered from the northern winds, is, for its latitude, an uniquely prosperous, densely settled farming community of several hundred families.

Thus is the stage set for Trondhjem, twentieth-century *entrepôt* and industrial center. But it is, at best, a bare stage, with little more than a backdrop and a few simple properties. Many of the actors are no more than "a voice, off-stage." And so, intrigued by the sense of drama, rather than by actual performance, I avoided the seat in the pit offered by the local tourist agency, and proceeded to scramble about backstage.

WHAT A BIT OF PROBING REVEALED

The city is the trading center for the little pockets of agricultural population—often consisting of but one family—scattered along the radiating valleys and on the fjord banks where there is occasional footing.

It is the outlet for such lumbering operations as may flank the mountains behind.

It is the focus of the fresh-fish activities along the northern coast. And it is, thanks to plentiful water-power and its ocean-facing harbor, the place for such manufacturing as local raw materials and needs justify.

These same statements, with little change, might be applied to many a great manufacturing city. Thus generalities cloak underlying facts. In the case of Trondhjem the first layer of underlying, qualifying facts are these. Agriculture is carried on with such difficulty in this northern world that only the hardiest crops, and those meager ones, can be grown. Lowland forests were long ago cleared off; the extreme uplands are too coldly sodden for vegetation other than tundra-growths—lichens, mosses, and dwarf willow. The steep slopes are scraped clean of soil except in occasional pockets which, holding soil, also hold water and are therefore bogs. Forests, as such, remain only far inland; indeed, in the case of Trondhjem, most of the forests lie across the border in Sweden.

In many populated parts of the world there is water power which remains undeveloped because of lack of local raw materials or neighboring markets. One can scarcely expect, at first glance, that the Leir Fall can justify much manufacturing in far off Trondhjem.

One factor remains to be appraised. It is the clear-headed, direct, and alert quality of the people, who have made the most of every meager resource the environment offers—a sum of little assets which, to most of us, would appear as one depressing liability.

More than an agricultural center, Trondhjem is a fishing town. It is a Gloucester, Mass., rather than a Lancaster, Pa. The northern coast has one blessing in its abundance of cod, a fish which is in no way exciting, but whose firm, cold-water flesh holds together and thus endures curing. Cod, wherever it is caught, is of first importance as the year-round, daily "meat" of the people. But for 500 miles beyond Trondhjem the shivery little fishing villages, with no other occupations for their inhabitants, produce a great surplus of cod. So dominant is this species that the published reports of Norwegian sea-exports list these two separate items:—"fish," "cod."

Another fish which cures well is salmon, far rarer than cod. These two, brought into Trondhjem, are salted, smoked, or sundried —occupation for a large group auxiliary to the fishermen. The heads are dried, ground, and shipped to Germany as fertilizer. From

the cod livers is extracted the valuable oil; the remaining offal, not to be wasted in so poor a land, has given rise to a growing silver-fox industry; the oily food makes for glossy pelts.

Fishing fleets foster other activities which scattered along the coast, would be rather insignificant, but which, gathered together in the logical metropolis, give that town's business new impetus. Fishing smacks and dories are built here, where the Swedish timbers spill down to the sea. Sails, rope, and net twine are made. Masts

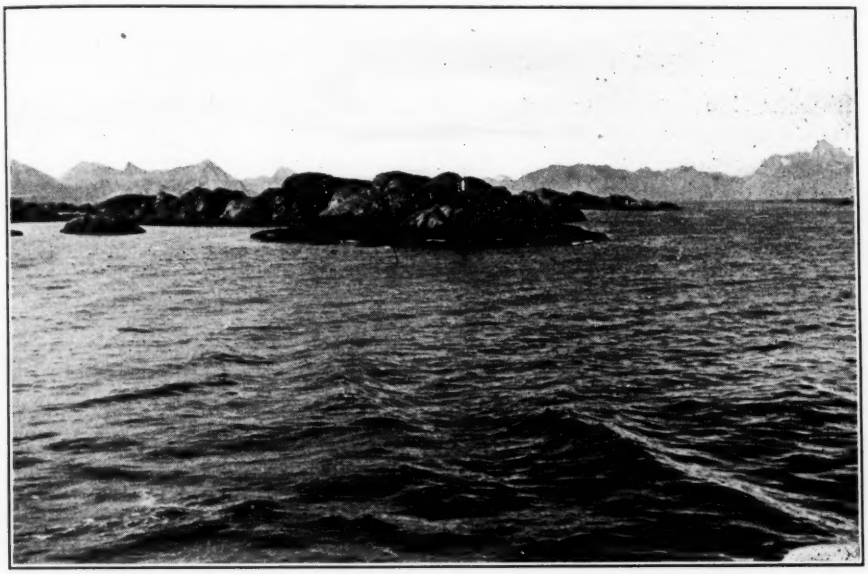

Fig. 3. The fishing ground. Thousands of rock islands which dot coastal waters furnish a protected passage-way from one tip of Norway to the other.

are trimmed. A boat from Portugal is unloading bales of cork on a quay across which a factory is turning out floats for the nets. Many of the fishing boats now have auxiliary engines; machine works and repair shops became necessities. The roe of fish and the small fry, such as herrings and "sardines," find their best market canned; hence canneries full of busy wives and daughters, and then, back on less expensive frontage, a factory making cans, and another, packing boxes. Still another concern turns out kegs for fish oils or for herring put up in brine.

To such a manufactural development has Trondhjem attained on the resource of fish alone. Most fishing villages which have aspired to manufacturing are content with canning.

As prosperity grew, folk put in furnaces and imported radiators.

But iron, again Swedish, finds its way across to Narvik on the Norwegian coast—especially during winter when the far northern Swedish harbors are frozen. The can-maker, metal-minded, quickly took advantage of that fact and added a foundry to his plant; radiators and many another casting were soon home-made.

Boats demand salt-resistant brass fittings. No one had the temerity to undertake a brass foundry until the less ambitious iron foundry paved the way, but government geologists had long since reported copper-bearing rock in nearby hills, and brass consists chiefly of copper.

There is, in the story of Trondhjem's growth, no better example of progressive civic team-work than that of the copper. The ore was of too low grade to have justified development for the copper alone, but now the urge to make brass and the habit of working with local rather than imported materials put the townsfolk on their mettle. The national government had made a friendly gesture and established a technical college in the town and the school's wide awake chemistry teacher became, at this juncture, the city's prophet.

There had long been an itch in the town to take toll of the Swedish and Norwegian wood tumbling from gondolas into schooners at the wharf and to make paper-pulp for export to England. The Swedes had set the example, but the Swedes, having sulphur, had gone further and made paper. There had been talk of importing the necessary sulphur from Sicily and adding paper-making to the town's activities. And now the prophet spoke. The copper back of Trondhjem was in combination with sulphur. If the town could use both copper and sulphur it would pay to break down the combination with the newly available electricity from the Leir Fall (Leirfossen).

Later, after a few preliminary rumblings, the prophet spoke again. The overhead costs of the electrolytic process might be cut down by a further nicety of separation. From the particular rock in which the copper and sulphur were combined (as copper pyrite) high voltage could produce carbide, the basis for acetylene gas—and Norway was considering a large number of new lighthouses and smaller beacons along the rocky coast between Trondhjem and North Cape.

It was all too easy. The government was surprised and delighted to be offered carbide in the very region of its consumption, and further carbide markets were found in South America. The brass

foundry is a success and a convenience and there is even a small surplus of copper for export. And paper became, in bulk, the town's chief product.

Bundles of reindeer hides and walrus and seal skins had long found their way to the wharves, while calf and goat skins steadily went thru the port *en route* from the valley dairy farms to industrial England or South Norway. Hemlock and oak with their tannin content would be scarcely more at home than quebracho in

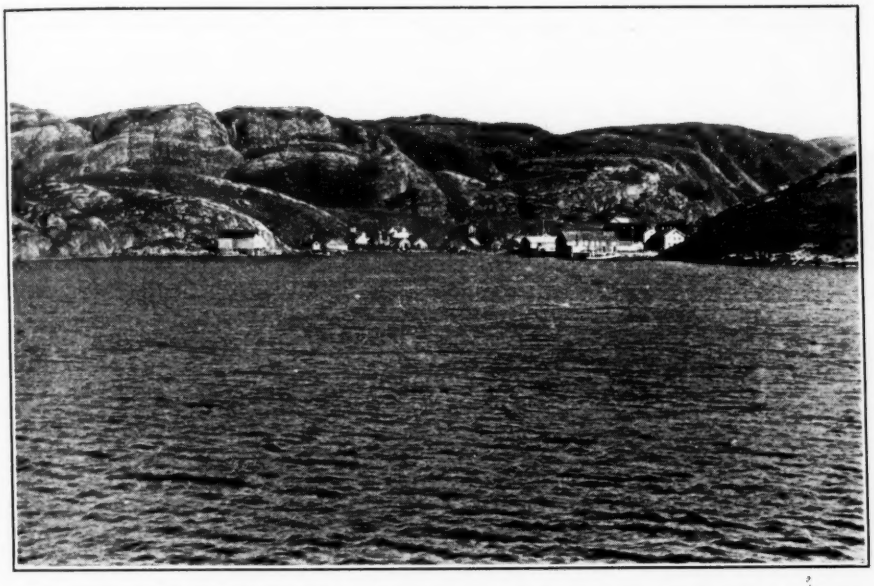

Fig. 4. Typical far-northern fishing village on a rock-bound coast. One-story dwellings dwarfed by warehouses for fish, barrels, salt, and nets.

Trondhjem latitudes, where even the Norway pine begins to yield to gnarled birch, with a sprinkling of mountain ash. But birch in Scandinavia is esteemed and widely used for tanning, and as Trondhjem became industrial-minded, the organization of this industry gave rise to another factory and surplus.

The new tannery eliminated the cost of exporting hides; farmers and tannery shared the saving. Shoes had alway been dear—that caption, "add 50 cents if you are ordering from west of Denver," would have a very familiar sound in over-the-mountains Trondhjem —and someone's brother-in-law down in Oslo was in the shoemaking business. Some savings subscribed, a few machines, the brother-in-law, and the honest Trondhjem leather, and northern

Norway became independent at last in the matter of good solid shoes—no fancy stuff!—and with a sigh of relief consolidated into an immediate, established, unbreakable market for the cheaper local product.

See how industry, escaping from the fish-drying stage, pyramided in the little town that had only hoped to remain quaint enough to amuse the cruise folk. The local harness store graduated into a factory and cancelled its down-country orders. More of the good Swedish iron was diverted and the Trondhjem region became independent as to nails, screws, and wire. (And with every new freedom from expensive imports, more jobs were available and more profits were distributed at home.)

The one grain of the region, tolerating sandy soil and brief, cloudy summers, is barley. Yeast staggers and falls by the wayside when put to the task of "raising" bread made of this non-glutenous grain. But barley grits, plus a dash of boiled and mashed runt potatoes—also at home in the humid north—may be spread thin on a hot plate and baked into something crisp and delectable.

Because barley is its grain, flatbrod is the Norwegian bread. And because of its barley, and its lack of other grains and of vines, beer is its drink—not iced beer on a hot day, but beer with a warming little kick for every cool or cold day in a land where all the days are either cold or cool. And so Trondhjem drew to its brewery, first a share of the little farmer's grain, and then shiploads of barley from the south. Cases of beer became important in the cargo loaded on the mailboat that starts north every morning.

The element of novelty is a very important one in international trade. Norwegian farm wives still make their own discs of flatbrod, with the central hole for storing on a pole hung beneath the ceiling. But the town folk buy a bakery product. The Trondhjem bakery has become a municipal institution, large and modern. When America and England discovered the novelty, flatbrod, the bakery, like everything else in town, became a "factory" overnight and added a new item to the fast growing list of exports, to bring good foreign money into town. Not to be outdone, the fish-canning plant experimented with mass production—at first for local consumption—of the other national dish—fiskeboller, or, as they now print it on many of their cans, fish balls. This delicacy, a pudding made of fresh cod and served as a variant of the everlasting fish, is popular thruout the country, but is best made in a port town. The Trondhjem

product, made in the best tradition and of such prime cod as no inland town can boast, broke down all old-fashioned prejudice. Soon a second cannery began to pay out wages and dividends, and fishermen had a new market for their catch.

As the novelty of Norwegian bread "caught on" abroad, the prospering Trondere in turn adopted that novelty, wheat, or white flour, bread. The first loaves were made of American flour, but nothing is bought that can be made, and soon an electrically-driven

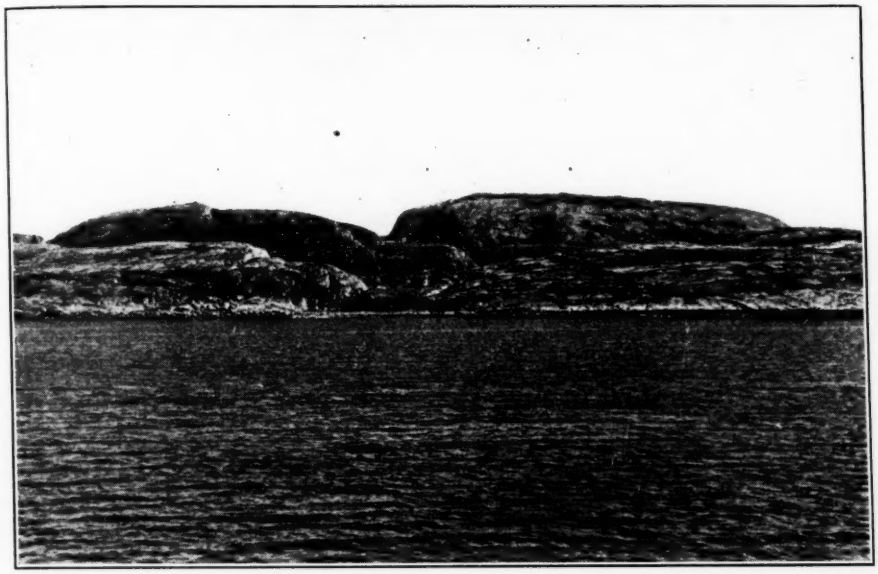

FIG. 5. One of the coastal farms which lie miles apart north of Trondhjem. The house in the middle of the picture marks the depression which conserves a little soil for potatoes and grazing. The owner of every such farm is primarily a fisherman.

mill was grinding the luxury, imported wheat. Soon, too, the local wheat flour was the basis for a cracker and biscuit plant, and the can factory began to turn out tin boxes with glass fronts which displayed good reproductions of Huntley & Palmers products in towns far from Trondhjem. Increased prosperity, plus local, tariff-free biscuits, quickly made a wide demand for these little English cakes which so well fitted the scheme of the smorgasbord but hitherto had been only for the rich.

With the flour mill anxious to sell its "shorts"—the by-product of milling—chicken farms began to fringe the town, located on the more sandy bits of glacial soil. These had been the lands of the

poorest farmers—the class least touched by the region's surge of prosperity because they could produce no surplus to sell. But in this climate, as in others less damp, chickens could profitably be raised only on the quick-drying sands, where poultry can be kept dry-footed and healthy. Stimulated by the new cheap feed and the home market's response to fresh eggs, this poorer farm group quickly overexpanded. As quickly a captain making weekly runs across to Newcastle and Edinburgh discovered that English and Scotch folk were accustomed to paying twice the Trondhjem price for eggs. The "shanty-town" Norwegians, within a year, had blossomed into self-respecting exporters. In two years each of them had added to his little red house a sun-porch—the desideratum, in this world of short winter days and cool summers, of every modern north-country dweller. The endless chain of Trondhjem's prosperity was finally dropping gold into the last empty basket along the coast.

The relation to England of farming countries peripheral to the North Sea is mutually important. North countries, for several reasons, are regions of dairy farming. Manufactural, urban England is fed by foreign farmers. Its butter imports are enormous. Breton and Norman farmers send it only such butter as they can spare without sacrifice. Less independent farmers of Belgium, Holland, and Scandinavia export all the butter England will take—which leaves them none for themselves or the less than rich town folk. It is an anomaly that all these intensively dairying countries eat margarine. The difference between the price of butter and of margarine leaves them the margin of profit which makes them prosperous.

Norway, facing a northern sea, is the world's most adept whale-fisher. Much of the whale oil has gone into soap-making—her own and that of others. But new technologies developed by necessity during the Great War have made whale oil into margarine—a very good margarine when vegetable oils are also used.

Today, soy oil from Manchuria and palm oils from Africa find their way to Trondhjem to be blended with the local whale oil supply which long ago established a little soap factory in the town. This supply of oil, plus old familiarity with its emulsifying, has made it logical and easy for Trondhjem to expand into margarine making. It followed that her dairy farmers, adopting the substitute for themselves, became exporters of butter to Scotland. And so a warehouse handling vegetable oils from far-off lands; more boats com-

ing into the harbor, and not one, but three new factories making brands of margarine which now sell all up and down the coast and in the interior valleys.

Much of the new English trade would scarcely have developed without the basic export of fresh fish. Halibut, salmon, sole, and lobsters are brought south from a dozen far-off fishing villages to Trondhjem, there to catch the daily fish-boat for England. Thus

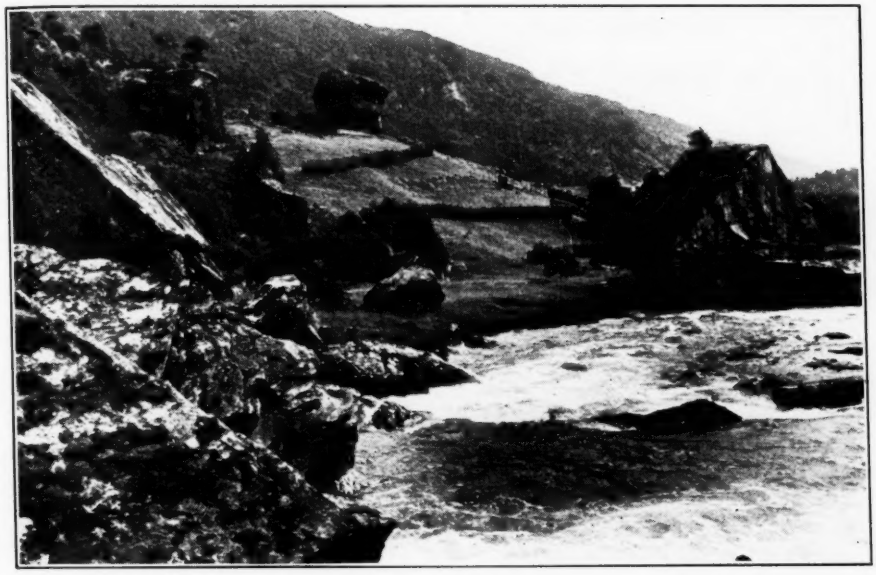

Fig. 6. A better coastal farm. The foot of a "slide" where soil and giant boulders accumulate. The hay hangs on long racks that the wind may dry it, since the sun's rays are rare and feeble.

fish quite distinct from the cod-herring-sardine brotherhood become important in a highly specialized way and fit into the smooth-running machine of Trondhjem's present-day expansion. Those slower, less frequent vessels that carry pulp to England's paper mills have added other forest products to their cargo. Such northern forests contribute no precious hardwoods, but Trondhjem is glad that England's needs include the ties, mine props, and telephone poles which may be brought down to her wharves and loaded onto her ships. The fishing boats returning northward to the banks increase the town's activities as an *entrepôt,* and carry firewood and building lumber to the fishing towns which, far enough north for cod, are too far north for trees. Even hay has to be shipped to these towns

where, altho horses are scarce, grass is still scarcer. There is something rarely reciprocal in the relationships of marginal lands, where trade seems to be as much a matter of the mutually helping hand as of commerce.

THRIFT IS ENCOURAGED IN NIGGARDLY ENVIRONMENTS

There is doubtless, somewhere, a carping critic who will protest that there must be some other available resource in this north country which I have omitted or the Trondere have overlooked. There *are* others, and for him I will add them here.

One of the canneries preserves, late in the fall, the tyttebaer, or wild cranberries, that crowd the bogs. English upholsterers provide a market for the moss that hugs the rocks. Dairymen buy the seaweed that drapes the shore—goats like it. And from the very air, Trondhjem, with its cheap electricity, is stealing nitrogen to fertilize lean farms.

For that same critic I will admit that the town has missed a bet or two. I couldn't find that glue is made (as it might be) from fish tails and fins. And the groceries, only two blocks from the salmon-drying plants, offer "fancy Alaska salmon" in the familiar tall tins. But this is not really a slip-up. Norwegians prefer their salmon, when not fresh, as laks, the native smoke-dried product. The few cans of American salmon that are sold in Trondhjem serve, not taste, but the craving for novelty. One suspects that a hostess occasionally "shows off" with a can of imported salmon: perhaps it would be more polite to say, "gains social prestige with a can of sockeye." The end is the same, surely. Alaska salmon, in Trondhjem, is "smart."

To offset its neglect of glue and canned salmon, Trondhjem has one product (but only one) which is an "introduced" commodity in no way related to local resources. There is no sugar-beet production in northern Norway and certainly no cacao is grown anywhere in Europe. Still there is a factory turning out chocolate bars of most excellent quality—enough for the whole north country. Northern folk crave sweets, especially in winter. Cruise passengers swell the demand for candy at Trondhjem. But the demand might easily have been supplied from Oslo. However, as usual in this progressive town someone knew what he was doing. Sugar from Germany (in exchange for fertilizer and fish) meets cacao sent directly from the African Gold Coast to fill out the cargo of palm nuts for the mar-

garine factories. The chocolate man gets a minimum shipping rate and as in Switzerland and New England there is local milk to add to the other ingredients. A poor product could not have established itself perhaps. But, either because the business is new, or because Norwegians are still inherently honest, the Trondhjem chocolate is of rare quality. Far down in Denmark we mourned the passing of the last bar in our lunch basket.

In America there is much talk about civic boosters of the "I

Fig. 7. An interior mountain farm. Nearly all Norwegian farmhouses are "log cabins," as are the older churches. Goats are most at home here, but added cow's milk improves the cheese. The number of boulders discourages attempts to remove them.

Will" spirit. In Trondhjem the spirit seems to have been, "I'm Started—I Can't Stop!" There has been no wild-cat element in the town's growth; no promotion schemes; almost, one suspects, no looking ahead. The town seems to have found itself, after static centuries following Hanseatic days, on a magic stair. As the top step is attained, always another step appears. And never has it occurred to the townsfolk to disregard the mute invitation of that further step.

The future? Will there be no end to Trondhjem's dogged trudging upstairs to ever-increasing prosperity? No last act and curtain to the drama that surges up there in the far north while the rest of

the world sits and bites its finger-nails thru the long entr'acte that we call the "depression"?

No curtain, one suspects; but, however long, a last act, certainly. Perhaps the most interesting thing about Trondhjem just now is the imminence of its arresting. The metropolis is safe. Always it will stand at the southern outlet of Northern Norway. Always it will hold what it has gained. But surely its great period has been reached.

The nurturing northern market which so definitely belongs to Trondhjem cannot be extended. The north-country has reached the saturation point; further population growths must move out—no new story for Norway. Neither fishing nor lumbering can be expanded. There isn't an arable acre unfarmed. Mineral potentialities seem definitely limited. A hundred power sites far south of Trondhjem, and therefore nearer raw materials and markets, demand development before Trondhjem will be justified in further harnessing of falls. True, remoteness and local needs have taught her the trick of manufacturing and given her the famed advantage of an early start in that field. But the necessary contributing factors of further available labor, increasing supplies of raw materials, and expanding market within her sphere are lacking utterly.

The towns in Europe which, however unwillingly, have most successfully conserved medieval picturesqueness are those which, after achieving riches and a certain splendor, lost the basis for their wealth and sat back to watch the centuries pass. Bruges, Pisa, Lübek, Carcassonne, Toledo, Aigues Mortes, Rothenburg, Venice—there might be a long list of such towns whose canal silted up, sea-route became outmoded, mountain pass lost its significance, or whose strategic value declined with new political boundaries. Trondhjem will join a distinguished group; and unlike many of these other relics of a sumptuous past, will retain the economic stature of her peak era.

If Trondhjem is a pretty instance of a metropolis supreme in its field, it is a more beautiful example of the inexorable limitations which environment sometimes imposes. It will be interesting to see what happens when the Trondhjem folk sense the diminishing power of that inertia which has carried them so far. How long then will they strive with their bootstraps? How long refuse to accept their ultimate destiny as inhabitants of a delightful, little, metropolis?

WHY FAILURES IN THE STUDY OF GEOGRAPHY?

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The purpose of this article is to assist teachers in the diagnosis of their own instruction and to offer suggestions for remedying failures. The content of the article is based partly on 283,000 answers written by children who took the preliminary test for the construction of the Hahn-Lackey geography scale and partly on hundreds of answers obtained since in the use of the scale. Many of these answers are wrong. In most instances the cause of failure on the part of the children to answer correctly can be determined. These causes are here classified and discussed, and suggestions for remedial instructions are offered.

Failure in geography means, of course, that the child who fails cannot do sufficiently well the work which is required of him in the study of the subject. There are, therefore, as many causes of failure in geography as there are different types of work to be done. Weakness in any one of these may constitute a cause of failure. If teachers know what kinds of work children must learn to do in geography, failures are not so likely to occur. After all, the most satisfactory method of treating failures is the ounce of prevention. But in spite of all the care teachers may exercise failures will occur. And when they do occur, teachers must be able to diagnose each case and apply a specific remedy; *for the remedy for failure in geography is not more geography, but more of that particular type of work which the class cannot do sufficiently well.* For the work of diagnosis teachers must be conversant with the possible causes of failures so that they may be able to determine which of the several causes is present when the work is unsatisfactory. We offer as causes of failure in geography the following.

READING SKILLS NEEDED

1. Many children fail, in part at least, because they do not possess all the reading abilities essential to the successful study of geography. To be successful they should be able to read accurately and rapidly informational subject matter for the following purposes: finding the topic sentence of paragraphs; finding the main points of a selection; giving a coherent reproduction; giving an

accurate summary; finding answers to questions; working out solutions to problems; exploring for directions to carry out activities; discovering and formulating questions, problems, and activities.

Our study shows clearly that reading disability in one form or another is one of the causes of failures. In case of trouble teachers should have no difficulty in determining which of the above list of skills is lacking. Each one can be tested directly in daily work or by means of more formal tests. Having discovered a specific reading disability, it should be easy to work out and apply remedial measures. This one thing is certain, every minute the teacher spends in teaching children how to read and study geography saves hours for both the teacher and her pupils.

KNOWLEDGE OF HOME GEOGRAPHY ESSENTIAL

2. Perhaps the one thing that causes more children to fail in geography than any other is the lack of concrete geographical experiences. Children who do not possess a fair knowledge of home geography, or possessing it, do not use it to acquire a reasonable understanding of world geography are bound to fail. To them geography is altogether in books and consists of a jumble of words strangely and mysteriously associated. Give them a question ever so real and vital and straightway they are in books searching for an answer among meaningless phrases. The clearest impression one receives from reading the 283,000 answers upon which the content of this chapter is based is the conviction that many of the failures to answer correctly are due to a lack of first-hand information.

How may the teacher know whether her pupils are weak in home geography? She may find out by studying the nature of the responses of her pupils both in class discussions and in written work. With the problem in mind she will soon discover whether the geography which her pupils know extends to realities outside of textbooks. If it exists only in books, their answers will be little more than an incongruous jumble of words.

A second method by which the teacher may find out whether her pupils lack first-hand information is that of using diagnostic, standardized tests. That is to say, tests that contain exercises by which the different types of work to be done in the study of geography may be tested. Final judgment as to whether a class is weak should be based not on one but on the average of several tests.

If it appears that children cannot do sufficiently well that type

of work which involves the interpretation of world geography as it is described in textbooks in terms of concrete geographic experiences, what is the remedy? First, more home geography, of course. The text should be materially supplemented by work in home geography. Special emphasis should be placed upon the local phenomena which are not understood. Whenever helpful, field excursions should be planned, experiments performed, pictures collected, stereoscopic views studied, sand table employed for illustrating and testing purposes, and verbal descriptions with abundance of detail provided. Second, more home geography is not all of the remedy. In order that home geography may give reality to the textbook the children must know their home geography *in the language of the text*. They cannot read their text as long as the language of geography is unknown to them. Finally, knowing home geography in terms of the language of the text the children should be required to use their knowledge to interpret the text. The teacher should avail herself of every opportunity to establish contacts between local and world conditions. More of the problems for discussion in connection with the study of the text should be related directly or indirectly to the life of the community in which the children live. The children will thus form a habit of reading the text in the light of their own experiences.

OLD IDEAS PUT TO WORK

3. Other children fail in the study of geography because they are not in the habit of using the information already acquired in the further mastery of subject matter. As suggested in the final paragraph of the preceding section, the child who is not in the habit of using his experiences in reading the text will find his geography meaningless. This alone would cause him to fail in the study of the subject. But such a habit has a yet greater disadvantage. It is an attempt to master geography as a collection of disconnected facts. Such an attempt is sure to fail. Success in the study of geography is attained only thru the discovery of relationships between the known and the unknown. The learner's chances of success are the best when he makes knowledge beget knowledge or when he enlists information to do battle for him in the further conquest of information.

But how is the teacher to determine whether failures or inferior work in her class should be ascribed to a lack of ability on the part of the children to use information already acquired in the pursuit

of information? Weakness in this type of work may be detected in several ways. First, by direct observation of the work which children do during the study and recitation periods the teacher should be able to discover whether they are in the habit of using information previously acquired in the preparation of their daily lessons. Second, the ability which children possess to organize geographical information is a fair measure of their ability to use the known in learning the related unknown. It involves the discovery of relationships between the old and the new. If a child cannot place the facts together that belong together, he is weak in the type of work under discussion. On the other hand, if his knowledge of geography tends to become a well-organized body of facts, he uses the old in learning the new. Finally, the teacher may discover weakness in this type of work by using standardized tests that are diagnostic. If the known is used in learning the related unknown, the two become associated. Any test that calls for the giving of relationships is, therefore, a test of this ability. A high score on such a test indicates learning in harmony with the principle of apperception.

If children cannot apply knowledge in the pursuit of further knowledge sufficiently well, what is the remedy? The answer is, of course, do not teach subject matter as isolated facts. If in the daily work the teacher has her pupils use the old in discovering the new, any weakness that may exist in this particular type of work will rapidly disappear. The ounce of prevention is more emphasis on activities, problem solving, and unit teaching.

Symbols Translated into Realities

4. Failures in geography are also caused because children do not fully master the different types of symbols employed in geography. Geography is necessarily a study of symbols. The earth has its symbol, the globe "on the convex surface of which are represented the countries, seas, and various parts of the earth"—all in symbols. At its best the map is to the child at first a conglomeration of symbols representing water and land, valleys and mountains, rivers and lakes, cities, railroads, and what not. Pictures, grafs, charts, diagrams—each employs symbols which should convey realities to the minds of children. The descriptive part of the text is full of symbols. Here is a short quotation from a text, selected at random, with symbolic terms in italics: "*South* of the *equator* the *southeast trade winds* cause *heavy* rains on the *east* coast of *South America;* then, *crossing* the *continent,* they *give up* more *vapor* in

rising up the eastern slopes of the *Andes*. The *air* is so *drained* of its *vapor* here, that when it *descends* on the *western side* of the *mountains,* there is little left." One need only to glance at the quotation to realize that geography is necessarily a study of symbols. The danger, then, is that in the minds of children the symbols represent no realities. How easy is it for children to read the above quotation by merely pronouncing the words without visualizing the things they represent, but how difficult is it for them to read it and form a mental image of what is described. Children will naturally do the easy thing and omit the difficult unless they are held to the opposite course.

Weakness on the part of pupils in translating symbols into realities can be easily detected. The teacher can improvise and use tests of her own or she may use diagnostic, standardized tests. If a class is found weak in this type of work, what is the remedy? May it be said again that the ounce of prevention is a better remedy for weakness in symbol mastery than is the pound of cure? The ounce of prevention is administered as follows: *develop the meaning first; then introduce the symbol;* keep associating the symbol and its meaning until one recalls the other at sight. The mere fact that the teacher is conscious of the danger of using symbols is a safeguard in itself against failures due to weakness in this type of work.

MAP READING ABILITY NEEDED

5. Inability on the part of children to interpret maps for the different purposes for which they are used in texts is another cause of failures in geography. The ability to use maps as a means of acquiring geographic information is so necessary that children who do not possess it are greatly handicapped in the study of the subject. That the children who took the preliminary test for the construction of the Hahn-Lackey scale were not skillful in the use of maps is proved conclusively by the character of their responses. Nor have the thousands of children tested by the exercises in the scale since its construction proved themselves stronger in the type of work involving map interpretation. It is not at all surprising that children should be weak in the interpretation of maps. The map is the most complex device used by geographers to impart information. And yet children seldom receive systematic instruction in the art of reading maps. As a result the map remains more or less a mystery to them.

The regular work should reveal the presence or absence of map-

reading ability. For this purpose formal testing is not so necessary. If weakness is discovered, what training are the children to receive? The best training the teacher can give her pupils to overcome the weakness is to continue using the map for the various purposes for which it is designed. Map reading as a source thru which information can be gained should begin in the lower grades and continue thruout the course. By the end of the fourth grade children should have acquired the map habit and with it considerable skill in reading different kinds of maps. As a framework of place geography they should have an accurate mental picture of the world as a whole with its continents, oceans, countries, some important cities, and some of the oustanding surface features. In harmony with the present trend in the teaching of geography, a more extensive use of the map should be made in all grades. Map study occupies an important place in working out a teaching unit in geography. Many of the activities that are now being used in the teaching of geography necessitate the use of maps. A new unit or region should be introduced thru its map. Map study of this type makes geography real to children, develops map-reading ability, and creates enthusiasm for the study of the subject.

PLACE GEOGRAPHY ESSENTIAL

6. This brings the discussion to another cause of failure in geography, namely, the lack of ability on the part of pupils to locate places, peoples, and activities. The teaching of place relations in our schools has a checkered history. At one time it was nearly all of geography, but within the last decade or two it has lost nearly all of its former prestige. At present its importance is once more on the increase, but still underestimated. To be able to locate a place with reference to its latitude and altitude, with reference to wind belts and calms, with reference to ocean currents or proximity to large bodies of water, with reference to natural resources and population regions, is to know half of its geography outright and to free the other half of most of its difficulties. Without this knowledge of place relations none of it is fully understood. To know, for example, that the Bermudas are in latitude 32° N., in the open ocean and surrounded by warm currents, with their highest altitude only 260 feet, is to know the most important part of their geography. That they have a delightful and equable climate which makes them an ideal summer and winter resort and that the inhabitants are engaged in raising early vegetables for the American market are facts

easily inferred from a knowledge of their place relations. Yes, a knowledge of place relations is fundamental in the mastery of geography. It cannot be neglected without fatal consequences.

That too little importance is attached to place relations is clearly shown by the results obtained in giving the preliminary test referred to in the beginning of this paper. Only thirty-four per cent of the children in the seventh and eighth grades could locate St. Louis and Cincinnati; only forty-two per cent could locate Dardanelles, Panama Canal, Mecca, Vera Cruz, and Singapore; only twenty-seven per cent could locate four important cities of Asia; only twenty-one per cent could name two important valleys of the United States near the Pacific coast; only twelve per cent could name the states passed in going by boat from Cincinnati to Memphis. These results definitely point to weakness in place geography.

A number of standardized tests are available to measure children's knowledge of place geography. To remedy any weakness discovered the teacher is urged not to let her work in place geography sink to the level of mechanical or memoriter exercises, *but to keep it on the project plane by making it a necessary part of a unit activity.* Place geography should be a by-product of the completion of a unit of work. Locating places should not constitute an exercise by itself, but should always form an essential part of a relationship problem. If place geography is so taught, it will not only reduce greatly the number of failures but it will also be instrumental in making geography real to children.

PRODUCTIVE IMAGINATION NEEDED

7. The 283,000 answers also indicate that children sometimes fail in geography because they lack productive imagination. They are not able to construct realities from verbal descriptions, pictorial illustrations, and geographic symbols. Much of the textbook geography is descriptive. If children cannot construct an accurate mental image of what is described, the only alternative for them is mere verbalism. They will get little or nothing from descriptions like the following: "At one time the earth was probably a white-hot sphere, like the sun, but in time the outside cooled to a crust of solid rock; the interior, still heated, continued to shrink and grow smaller, as most substances do when cooling. This caused the solid crust to settle and wrinkle, much as the skin of an apple wrinkles when the fruit is drying. Water collected in the lower portions, making the oceans, while the higher portions formed dry land. Thus

North America and the other continents were born." If such descriptions do not arouse vivid mental images in the minds of children, they become satisfied with the empty form of words. When this kind of formalism becomes habitual with children, nothing but failure can be expected.

As remedial measures for weakness in this type of work, verbal descriptions should be supplemented abundantly by the use of pictures. Modern texts are full of pictures which should be made to serve the imagination of children. Magazines, books of travel, railroad and steamship folders, advertising materials sent out by different industries, all contain pictures which, if collected and properly classified, will assist the imagination and enable children to see and understand fully what the text describes. Second, first-hand geographical experiences gained thru a study of home geography are fundamental in the training of the imagination. The teacher should therefore see to it that her class has an abundant supply of concrete imagery needed in the study of geography. Third, the teacher must be sure that geographical symbols have real meaning to her pupils. Fourth, the most helpful aid to the imagination is material with an abundance of detail. Such descriptive matter is an antidote for memoriter work in geography. Not only is the imagination stimulated but interest is also aroused by detailed descriptions.

Ability to Discover Relationships

8. Lack of ability to think inductively is another cause of failure in the study of geography. The child who attempts to master this subject by learning pages of facts to him unrelated and unorganized usually fails. He fails for the simple reason that the ordinary text contains far too many facts to be learned successfully in that way. The mastery of geography as a mere collection of facts is beyond the ability of even the most gifted children. But it is comparatively easy to master the subject when its facts are grouped under large controlling principles. Geography on the side of accumulation of facts is flexible and unlimited, but on the side of law and relationships it is rigid and definitely limited.

The advantages of a campaign with principles or relationships for its objective over one aiming at facts are threefold: first, there are fewer principles than facts; second, facts usually appear only once and are thus easily forgotten, while principles illustrating and controlling many facts appear many times and are therefore re-

membered; third, the scientific attitude is developed by a study of principles rather than by a study of facts as such. But even facts themselves are more easily remembered and understood when they explain things. It is therefore fair to say that if relationships were emphasized in the teaching of geography instead of facts, children would be more successful in the study of geography and the number of failures would be greatly reduced.

But the mere memorizing of principles is not enough. Principles may be memorized divorced from their meanings the same as facts or symbols. The one is as bad as the other, and neither assists children in the mastery of geography. Principles should be derived from concrete data or experiences. When so derived, they become associated with a fair sample of all the facts which they explain and control. This association enables the child to recall the appropriate principle when a fact presents itself for explanation. Memorizing principles without forming such associations would defeat the very purpose for which they are to be learned. Inductive thinking is one of the most important types of work which children are called upon to do in the study of geography. Unless they are taught to do it well, failures will be inevitable.

Ability to Use Relationships

9. It may be said, finally, that children fail at times in their work because they cannot use sufficiently well the principles or relationships which they know in the further mastery of the subject. A principle in geography is not to be learned for its own sake. Only a small portion of facts or conditions which a principle explains can be used in its development. The greater portion of the facts belonging to the class controlled by the principle is still unexplained and unknown to the children. It is for the explanation of that portion of the class of facts which at the time the principle is developed lies outside the children's experiences that the principle is needed. Again and again children should have occasion to say: "Here is another," until the principle is made world-wide in its application. Deductive thinking thus becomes a short cut to knowledge-getting in the study of geography. Every principle or relationship discovered should mean hundreds of facts mastered. Children who have little or no ability to think deductively in this subject have little or no chance to succeed. It is encouraging to know that both inductive and deductive thinking are being stressed increasingly in the teach-

ing of geography. It is the one thing that saves geography from becoming a humdrum subject of study to children.

According to our analysis there are thus at least nine types of work which children must learn to do well, if they are to succeed in the study of geography. The inability on the part of the child to do any one of the nine kinds of work may cause him to fail. In case of failure the teacher should find out what it is that the child who fails cannot do. Having found out, she should give him specific training in the kind of work in which he has failed. It is only by this procedure that satisfactory progress can be made by children in the study of geography.

COLUMBIA RIVER DAMS AT BONNEVILLE AND GRAND COULEE

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When depression caused a national emergency our United States Government decided on a public works program to benefit the unemployed. Among the largest of all the projects under construction with P.W.A. funds are two great developments on the Columbia River: Bonneville Dam and the Grand Coulee Project.

At Bonneville the damsite stands 150 miles from the Pacific in the midst of green forests that clothe the Cascade Mountains across which the Columbia has carved a mighty gorge. At Grand Coulee, three hundred miles upstream from Bonneville, the damsite location is in a sagebrush desert and occupies a somber canyon whose lower walls are gray granite changing towards the top to basalt, a brown or black lava. The government will spend $33,000,000 at Bonneville and has appropriated $63,000,000 for Grand Coulee which will require much more money for the high dam now planned. That these dams will have important geographic effects in the Northwest goes without question. That the results will be generally beneficial seems certain. Unfortunately, the salmon industry, worth $10,000,000 annually on the Columbia River, will not benefit from the construction and may indeed suffer injury. However, the United States Bureau of Fisheries recognizes the problem and the Government will install adequate devices that should save the industry.

BONNEVILLE DAM

The Bonneville Dam has a location on the Columbia River 150 miles upstream at the limit of the tides, affecting the lower course of the river, and downstream from the first rapids called the Cascades. Here in the midst of the Columbia Gorge, Bradford Island separates the Columbia into north and south channels. Bonneville Dam will consist of two sections between Bradford Island and the mainland shores.

The main dam, located between Bradford Island and the north

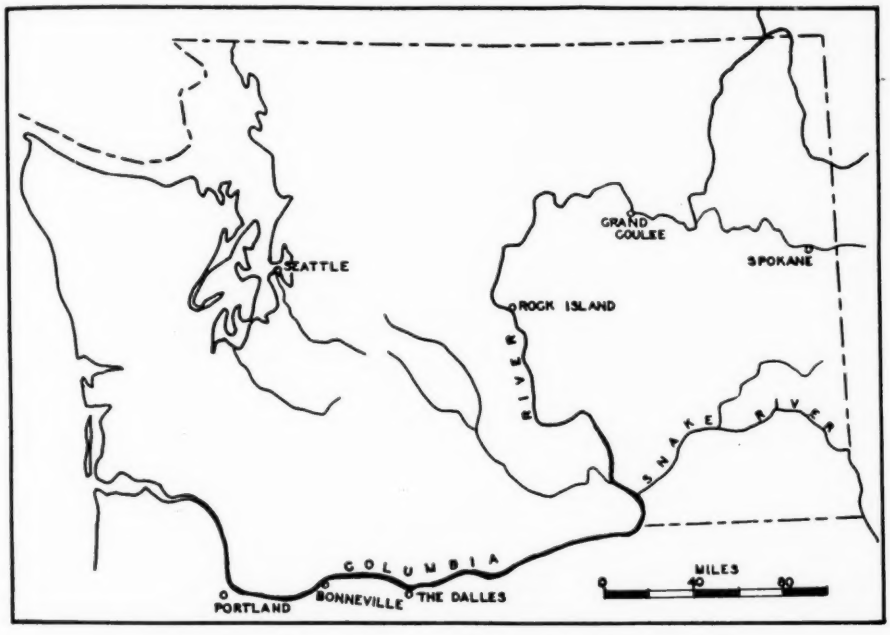

FIG. 1. The Columbia River region showing location of the Bonneville and Grand Coulee projects.

bank in Washington, crosses the widest channel. This dam has a length of 1,250 feet. No power house is located on this section which serves as a spillway for the surplus flow of the river. Here 18 flood gates will control the flow of the Columbia which sometimes exceeds a million second feet.

The south channel, between Bradford Island and the Oregon shore, will contain a power house, navigation locks and fish elevators besides the dam itself.

The Bonneville Dam should have an important effect on water

borne commerce. The artificial lake above the dam will have an elevation of 72 feet above the sea and will extend for a length of 45 miles. This lake will cover the Cascades of the Columbia which drop 37 feet in 5 miles and will fill the river gorge clear to The Dalles. The Columbia River below Bonneville will be dredged to a depth required by ocean freight steamers, probably a 30 foot channel. Then navigation locks, said to have the highest lift, 70 feet, of any single locks on earth, will raise the boats to the quiet pool up which this commerce may continue to Big Eddy at the entrance to the Celilo Canal built around The Dalles of the Columbia. The locks are 500 feet long and 76 feet wide yet can be filled or emptied in 12 minutes. The locks are excavated from solid rock. It is expected that at the city of The Dalles, Oregon, river steamers and barges will deliver their cargoes of wheat, lumber, wool and other commodities to the ocean boats. The Bonneville Dam should greatly improve navigation on the Columbia and cause a large increase in the traffic carried on that waterway. For several years few boats have operated from Portland to either Hood River or The Dalles and freight transported thru the Celilo Canal has been negligible.

Power production is another purpose of the Bonneville Dam. Two units will be installed at once to produce 115,000 horse power. Ultimately four more units will be added. The plant can then generate 575,000 horse power. The present development of the dam and other structures will cost over $32,000,000. Portland, only 42 miles away, can consume much of the power. Industries should be attracted to the Northwest by the cheap power. In fact one industrial concern has already made an offer for all the available power at Bonneville.

The dam and almost all other construction work at Bonneville is done under contract by private firms. Engineers of the United States Army drew the plans and help supervise construction. A model town has been built on the Oregon bank for the use of the government engineers and other employees. This will remain the permanent residence of those employed in the power plant, etc. Nearly 3,000 men have found employment with the contractors. These workmen live in dormitories, houses, shacks and tents in "boom" towns located near the damsite on both sides of the river. Many thousands of people now live where two and one-half years ago only a few dozen homes were scattered along the forest clad slopes of the Columbia Gorge. Two railroads and two highways

FIG. 2. View of Bonneville Dam from the east. Bradford Island is in the center. The navigation locks, power plant and fish elevators will be on the left—and the spillway dam on the right of Bradford Island.

must be raised and relocated. The whole aspect of the site is changing rapidly.

In building the dam, every modern device to increase efficiency of labor is used. Giant cables cross the Columbia River and deliver material and even men where needed. The concrete is mixed in a central plant and carried wherever construction requires. The dam must be built in a firm rock foundation. Large coffer dams change the course of the Columbia and lay bare the river bed for the removal of loose material. After this section of the dam is built, the process is repeated until the completion of the whole structure.

GRAND COULEE

The Grand Coulee damsite is near the junction of Okanogan, Douglas and Grant counties in north central Washington. After its confluence with the Spokane River the Columbia River has cut a course across the Columbia Plateau in the shape of the letter S. The upper half of the S encloses the Big Bend country of Washington. During the Glacial Period a sheet of ice, thousands of feet thick, moved south, thru the Okanogan Valley from the Fraser Plateau of Canada. This glacier completely blocked the Columbia Valley, here 2,000 feet deep, and after crossing this canyon retained enough energy to move 30 miles south over the Waterville

Plateau before the ice all melted. The ice dam in the Columbia was over half a mile thick and fully 30 miles wide. Upstream the water from the glaciers was stopped by this barrier. A lake occupied the valley and has been named glacial Lake Nespelem. This lake rose until it overflowed southward across the lowest notch in the Waterville Plateau. For a long time, until the ice dam finally wasted away, the glacial flood waters occupied this new course and eroded there a deep canyon, called the Grand Coulee. The Grand Coulee is 50 miles long, from one mile to over five miles wide, and 900 feet deep. The lower coulee, 20 miles long, ends at Dry Falls (3 ½ miles wide and 420 feet high). The upper coulee continues 30 miles to the Columbia. It has a flat floor that stands 600 feet above the level of the Columbia River. The Grand Coulee is a desert. When the ice dam disappeared, the water resumed flowing thru the Columbia Valley and abandoned the Grand Coulee and Dry Falls entirely.

After flowing thru the Grand Coulee the glacial-melt water spread out over the Quincy Basin before emptying into the lower Columbia Valley. Much of the Quincy Basin was covered with fertile silt from the muddy water. Here nearly one million acres of land could grow excellent crops except for lack of rainfall. The dry climate makes the land desert that requires irrigation. Unfortunately there are few springs, lakes or streams to supply water, and ground water generally lies so deep that pumping is expensive. The Columbia River could supply more than enough water but the fertile soil lies hundreds of feet above the river and high pumping costs prohibit such a source for irrigation.

The solution for reclaiming the Columbia Basin desert consists in building a dam across the Columbia River just below the Grand Coulee and turning water thru that abandoned stream channel to irrigate the land by gravity. However, to turn the Columbia River thru Grand Coulee would require a dam over 600 feet high. This would flood much valuable farm land upstream clear into Canada and would even cover with water large hydro-electric plants on the Spokane River. It would cost so much and do such great damage to property that such a high dam was not seriously considered. Instead the dam will be high enough to raise the water most of the lift required. Then electricity, generated at the dam from falling water, will pump water for irrigation the balance of the distance to the floor of Grand Coulee.

Grand Coulee Dam is under construction across the Columbia

River and not in Grand Coulee. The Columbia River has here cut its canyon into hard granite that underlies the lava flows that built up the Waterville Plateau portion of the Columbia Plateau. The Columbia River here flows north for several miles and Grand Coulee enters from the southwest. The Columbia has deposited in the past enormous flat topped terraces of sand and gravel, hundreds of feet thick, along both banks. To secure a solid foundation for the dam the gravel must be removed back to solid granite and

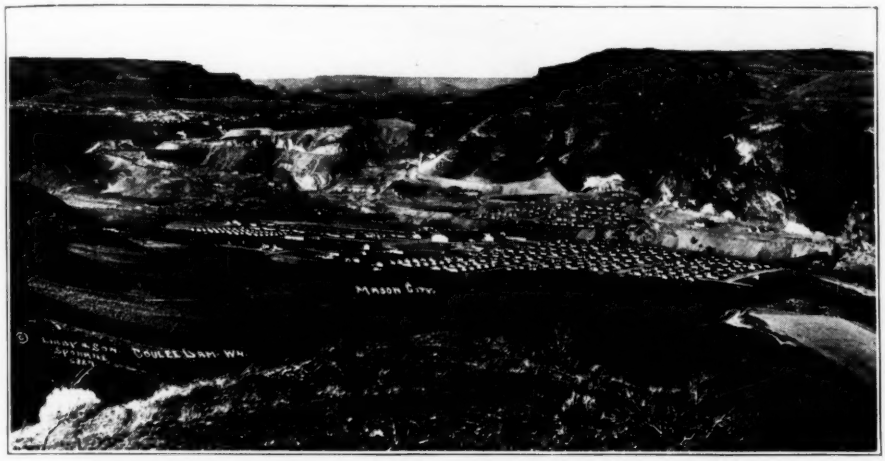

FIG. 3. Grand Coulee Dam Site on the Columbia River. Mason City, the contractor's town, is in the foreground. This has a population of 3000 and the buildings are all heated by electricity. The engineer's town was built by the government across the river. This will be a permanent town. The dam site is upstream from the engineer's town. The Grand Coulee begins in the notch above the Columbia River. Private town sites occupy land at the head of Grand Coulee. At the left center is the west bank coffer dam from behind which the conveyor belt system transports material up into Rattlesnake Canyon.

all the boulders and mud in the bed of the Columbia River also dug out down to firm bed rock.

Engineers of the United States Reclamation Service made the plans for the dam. About two years ago preliminary contracts were let for core drilling into the granite to determine its fitness for a dam foundation, for building two bridges over the Columbia, for excavating over one million cubic yards of overburden, grading, for dwellings and other construction. Finally in September, 1934, a group of New York, Iowa and California contractors doing business under the name of Mason-Walsh-Atkinson-'Kier Company, were given the contract to construct a dam 300 feet high and 3500

feet long for the sum of $29,339,301. This was called the "low" dam. Less than a year later plans were changed and the development now planned will be for a "high" dam around 450 feet above low water, or 500 feet above bed rock and 4,000 feet long at the crest. The present contract as changed will remove the overburden and construct the wide foundation required by the high dam only a short height above normal river flow. Further appropriations will be needed to complete the high dam.

In excavating the site for the dam the contractors have used some remarkable methods. Around 16,000,000 cubic yards of material had to be moved. Big trucks, some of 25 yards capacity, moved much of the upper overburden but would be slow and expensive for carrying away the bulk of the material. New methods were tried. First a great coffer dam of steel piling, 90 feet long was driven down to bed rock on the west bank of the river. Then material enclosed behind the cofferdam was excavated to bed rock and the debris carried off on the world's largest conveyor belt. This conveyor system of wide endless belts was built in several sections and finally dumped the material into Rattlesnake Canyon. So efficient did this conveyor system prove that the balance of the material requiring excavation on the east bank of the river, not yet moved by trucks will be carried across the Columbia on a suspension bridge and also dumped into Rattlesnake Canyon. After excavating to bed rock behind the cofferdam the foundations of the dam will be completed this winter on the west side. The dam will be built in sections across the river which will be shifted by cofferdams as required by the work. A big central plant will mix the concrete. Supplies of sand and gravel occur locally. Four million barrels of cement have just been purchased to meet requirements for next year. In all 11,000,000 cubic yards of concrete will be required in the projected high dam. This is nearly three times the volume of concrete poured at Boulder Dam which is 730 feet high but only 1,180 feet long as compared with 500 feet above bed rock and 4,000 feet on the crest for Grand Coulee Dam.

It is expected that 2,600,000 horse power could be developed at Grand Coulee altho plans provide for producing only 647,000 horse power at the start. This power will be sold for pumping water and domestic use on irrigated land in Okanogan Valley or other places and perhaps by some factories or other large consumers. In addition, electric pumps will raise water to the floor of Grand Coulee.

Here two retaining dams, one near the head of Grand Coulee and the other above Dry Falls, will form an artificial lake from which water will flow by gravity to irrigate over one million acres of land in the Columbia Basin. Engineers have estimated that around $390,000,000 will be required to complete the high Grand Coulee Dam and the Columbia Basin Irrigation Project However, revenues from the sale of power should reduce the cost for irrigation to perhaps $250,000,000.

Land proposed to be irrigated under the project has suitable soil and climate for successfully growing apples and other fruits, alfalfa for dairy cows and other livestock, grain, etc. If 1,200,000 acres are irrigated and 30 acres are allowed to a family the project could support 40,000 families or 200,000 people by agriculture alone. Probably as many more would live in the supply towns, work in manufacturing establishments, transportation agencies and other occupations dependent on the project. It seems conservative to believe that the project might double the population of eastern Washington in 25 years.

EFFECT OF DAM CONSTRUCTION ON SALMON

Building great dams on the Columbia will improve the river for navigation, will develop millions of horse power which may find use in mills, metallurgical and other work and will irrigate over a million acres of desert land. As a result the population should increase by hundreds of thousands and the wealth produced yearly by hundreds of millions. However, the salmon industry is seriously threatened by the dam construction and if the worst happens, may be largely destroyed. The government recognizes the danger involved and has employed a group of experts to devise schemes to save the salmon industry if possible. Since the salmon industry of the Columbia River has a worth of $10,000,000 a year some way should be found to perpetuate it.

Four species of salmon ascend the Columbia River to spawn. The best spawning grounds have a gravelly bottom in some shallow stream or lake shore. When laid salmon eggs are covered with gravel and after the hatching the infant fish hide among the stones and gravel until the yolk-sac is absorbed and the fingerlings have agility enough to dodge ferocious trout and other enemies. After some months the young salmon migrate to the ocean where they reach maturity. It has been determined definitely that the great

majority of salmon return to spawn in the stream where they were born. Anything therefore which destroys the spawning grounds, or prevents migration of fish upstream in some river will quickly exterminate salmon in that stream. In moving to the spawning grounds the salmon swim against the current. Slack water above a dam may prevent some fish from finding their upstream.

Already one dam blocks the Columbia. This is at Rock Island near Wenatchee, built by a private power company. The act of Congress that allowed the dam to be built required the company to install two fish ladders. Salmon ascend these in considerable numbers but whether enough reach the spawning beds will require observations lasting several years. A third fishway is planned for installation at Rock Island. Since Rock Island is a low dam here the water falls only about 30 feet and the fishways work fairly well, it should not seriously injure the salmon industry. The real danger lies at Bonneville and Grand Coulee.

The Bonneville Dam is twice the height of the Rock Island structure. Fish ladders are being built at Bonneville on both sides of Bradford Island and both mainland shores. Special spillways of swift water will attract salmon into the ladders. A fish ladder consists of a series of pools with a short falls between each pool. The salmon follow the swift water and by quick contractions of their bodies "jump" upstream from pool to pool. The Bonneville fish ladders will require a length of many hundred feet for the required rise of 65 or 70 feet. To supplement the ladders the government will build two fish elevators. An outflowing current of water will attract salmon into a compartment. The lower gate will then be closed and water will be admitted to raise the fish 66 feet to the level of the pool above the dam. When the upper gate is opened the fish will swim out or if necessary can be forced out by a plunger. It seems probable that these schemes will allow many salmon to mount the barrier offered by Bonneville Dam. However, slack water above the dam may not encourage the rapid migration of fish upstream as the swift Columbia does at present. On returning to the sea young salmon might be injured by passing thru the power plant. It is therefore planned to construct three or more special by-passes for downstream migration. The total cost of these facilities for the migration salmon will be between $3,000,000 and $4,000,000.

While it is hoped that most salmon migrating upstream can surmount the Bonneville barrier and that fish returning to the ocean can survive the seventy foot plunge at the dam, no such hopes can be

entertained at Grand Coulee where a 450 foot dam is contemplated. Salmon that spawn in tributaries of the Columbia below Grand Coulee like the Snake, Yakima, Wenatchee and Okanogan rivers will not be affected. Salmon that now breed towards the headwaters of the Columbia in Canada cannot hope to reach their spawning grounds. Grand Coulee would be too high for fish ladders and probably for fish elevators. The government will build large hatcheries and rearing pens, catch the salmon that will mass below the dam and try to maintain the numbers of future salmon runs by turning the young fish back into the Columbia. Whether this will work no one can tell for certain now. Many specialists on fish biology fear that the salmon runs will be seriously depleted by the new Columbia River dams. However, other experts believe that the means proposed by the government will save the salmon industry. Time alone will tell what the final effect of the dams will be on the spawning salmon.

THE ARTIFICIAL PEARL INDUSTRY OF CAPE COD

MINNIE E. LEMAIRE
State Teachers College, La Crosse, Wisconsin

How many people can picture a river herring or an alewife adorning the necks of many beautiful women? Probably for many of us a proof must be presented, even tho such circumstance very likely takes place every day in the year. Salt water not only produces the real pearl but also provides for many of the artificial ones.

The synthetic manufacture of pearls comes to us from early times. Jaquin, a French rosary maker, is generally credited with its discovery. One day he happened to notice a lustrous substance in some water which had been used to clean a few "bleak" fish. On obtaining some of this material he applied it to some alabaster and thus originated the first artificial pearl. A destitute French noble, learning from one of his servants of this new process, bought a lovely string of pearls at a low price and completely fooled his beloved. Other countries have been successful in producing artificial pearls, some of which are France, Germany, Italy, Spain, and China. Not until the World War when the United States secured an inferior essence, as the product was now termed, did anyone in this country become especially interested in supplying the home demand.

Cape Cod today lays claim to such an unique industry, the products of which are known as "The Native Pearls" and "Pearl Es-

sence.'' Herring, in the month of May, head up fresh-water streams to spawn and thus make themselves easy prey for the fisherman's hand-nets. Tons of these fish are taken yearly from the streams near Hyannis, ninety per cent of which go to this industry. Having amassed this large catch, everything is now ready for the first step in the process of transforming the lowly fish to pearls. Men and women start to work scaling the many fish for only the top part of the scales which are rather silvery in appearance can be used. The residue becomes either bait or fertilizer. The scales are placed in a large wooden tank that contains a secret chemical preparation. The mixture is then agitated until a crude essence appears. A refining process follows which includes the curing of the essence in an ammoniacal solution where it takes on a silky silvery color. Finally the pearl essence mixed with lacquer, easily recognized by the familiar banana like odor, forms a paste.

Now that the pearly portion is ready for use, what next? There must be a base on which this material can be placed. A large cane of glass, about three feet long and a quarter of an inch in diameter, is melted and cut into many small pieces, sometimes all the same size and other times of varying sizes. A small molten mass of glass, on a small piece of copper wire, is put into a flame and whirled until a perfect sphere has had a chance to develop. After allowing these small spheres to cool, the copper wire is cut off as close as possible and that which remains within the glass is dissolved by nitric acid.

The most interesting phase of the whole procedure brings a delightful little pearl into existence. The beads of glass, attached to a toothpick, are dipped into the paste, a very delicate task which necessitates a certain temperature and a dry atmosphere so that hardening may go on evenly. Then a truly beautiful pearl, guaranteed not to crack, peel, or discolor, is ready to be strung with other small iridescent orbs which, in turn, make up a handsome rope of pearls and are objects of desire. Color may be added to the paste with the result that many strings of daintily tinted beads make this industry still more fascinating. In addition many small animals, looking especially intriguing in their beautiful sheen coat of pearl, grace the shelves of the showcases where all products are placed before the eyes of the public.

Too often we think of science in connection with the great steel machines or the many automobiles, forgetting that it also has its place in the artistic world in creating such items as perfumes or artificial pearls.

EDITORIAL NOTES AND NEWS

The National Council of Geography Teachers in coöperation with the National Education Association sponsored three half day sessions at the Portland meeting, June 29-July 2. Erna Grassmuck Gilland was the program chairman, with Helen Galbraith of Portland in charge of local arrangements. Ideal weather and a forward looking program brought several hundred in attendance.

At the first session, with A. A. Enna, Franklin High School, Portland, presiding, the major topic was, Northwest Industries, a new course for Seattle High Schools, by Carl H. Mapes, Lincoln High School, Seattle. The forum discussion was led by Willis B. Merriam, Geography Department, University of Washington, assisted by Jessie Whitehill, Junior High School, Leetsdale, Pennsylvania.

H. V. Herlinger, Superintendent of Schools, Mount Lebanon, Pittsburgh, presided at the second program which follows. Teaching International Geographic Relationships, O. W. Freeman, President Pacific Coast Geographers; Regional Planning of the Northwest, Marshall N. Dana, District Chairman, Pacific Northwest Regional Planning Commission, Portland, Oregon; The High School Needs Geography, Jessie Whitehill, Junior High School, Leetsdale, Pennsylvania; Geographic Aspects of Erosion Problems in the Pacific Northwest, W. A. Rockie, Regional Conservator, U. S. Soil Conservation Service, Spokane, Washington; Regional Contrasts in Japan (Illustrated), Frances M. Earle, University of Washington, Seattle, Washington.

N. D. Showalter, Superintendent, State Department of Education, Olympia, Washington, presided at the last session which featured this program. The Place of Geography in the Education of Elementary Teachers, R. W. McNeal, Southern Oregon Normal School, Ashland, Oregon; Geography in Every Day Living, Cora P. Sletten, Asst. Editor, Journal of Geography, State Teachers College, Mankato, Minnesota; Using Local Situations in Teaching Geography, Vivienne S. Worley, Bryant-Webster School, Denver, Colorado; Radio Broadcasting in Geographic Education, Helen Johnson, Broadcasting Director, American School of the Air, Columbia Broadcasting System, Inc., New York, New York; The Algerian Kabyles—A Study in Mountain Adjustment (Illustrated), Howard H. Martin, University of Washington, Seattle, Washington.

The following information concerning an interesting new organization and publication has been supplied by Dr. Eugene Van Cleef, Ohio State University. The Baltic Institute, with headquarters recently removed from Torun to Gdynia, Poland, has inaugurated the publication of a splendid journal, which contains much that commends it to the geographer. The purpose of the journal is to acquaint the English speaking world with the activities of the Baltic countries, a little more than fifteen millions of whose natives live in the English speaking countries.

Representatives from each of the Baltic countries constitute the Editorial Committee. Others interested in the Baltic countries have been selected as contributors. The fields of interest emphasized are primarily history, economics and geography. Not only do the articles concentrate upon these aspects but, in addition, there is included an extensive series of reviews and a cumulative set of statistical tables and a bibliography.

If the present standard is maintained in future issues, this publication will constitute an important contribution to our knowledge of the Baltic countries and certainly will merit the support of those who desire to know more about this part of the world. Incidental to the treatment of the Baltic countries, occasional mention is made of Germany, the U.S.S.R. and Norway, which technically are not classified as Baltic.

Altho the journal is frankly propagandist in its objective, it is not to be classified with unreliable propaganda but on the contrary is accurate and dependable in every respect. The mechanical make-up of *Baltic Countries* is attractive.

DR. C. LANGDON WHITE, formerly of the School of Education, Cleveland, Ohio, has been made professor of geography at Western Reserve University.

DR. RALPH H. BROWN has been granted a sabbatical furlough from his duties as assistant professor in the University of Minnesota in order to undertake a comprehensive study of the historical geography of regions in eastern North America. Commencing in September, the study will be carried on during the following year. Literature and maps available at the American Geographical Society, the Widener Library at Harvard University and the Congressional Library in Washington will be investigated. The study is to be aided by a grant from the National Research Council.

WILLIS B. MERRIAM, University of Washington, will this fall, join the staff of the geography department of the University of California at Los Angeles in a new division of service in the field of economic geography for the School of Economics and Business.

More than twenty million tons of glauber salt ($Na_2 So_4$) has been proved in northwestern North Dakota, associated with a chain of shallow lakes extending into Saskatchewan. The sodium sulphate content ranges between eighty-six and ninety-four per cent. The paper-pulp industries and glass plants probably will be the markets for this salt.

GEOGRAPHICAL PUBLICATIONS

Daniel R. Bergsmark. **Economic Geography of Asia.** Prentice-Hall, New York, 1935, 618 pp., 197 maps and illustrations. $3.50.

In this first American college text on the geography of Asia the purpose of the author has been to present "a framework or structure in which more detailed information on the economic geography of Asia may find a proper setting."

Part 1 presents in five chapters the distinguishing characteristics of the continent as a hole; space relationships; physical framework; climate; vegation and soil; and population and occupation of the people. The succeeding five parts divide the continent into major regions—Southwestern Asia, Indian Realm, Southeastern Asia, Eastern Asia and Northern Asia.

Southwestern Asia includes esentially the dry lands altho Russian Turkestan which is so closely related in climate, agriculture and history is left to the last part of the book to be discussed with its unlike neighbor Siberia. The author has given a well balanced analysis of the economic geography of this division. Some confusion to students may result from treating in succession Turkey, Palestine, Arabia, Iraq and Persia and then going back to the west to consider Syria, Cyprus, Trans-Jordan and Afghanistan thus interrupting the continuity of study.

The Indian Realm is treated more completely and authoritatively than any other division of the book. The author shows greater familiarity with this division and consequently gives a detailed regional treatment of agricultural activities and economic development. Twenty regions are considered. Such minute analysis has a tendency to throw this section out of balance with other parts.

The fragmental divisions of southeastern Asia have been drawn together in a semi

economic-regional manner. Siam and British Malaya; French Indo China; Java; Sumatra, Borneo and other East Indies; and the Philippines comprise the various subdivisions. The products of these scattered divisions are studied in relation to world markets. Some regional distribution of crops and production regions is made but lack of uniform treatment is a disadvantage, for students must frequently change their mental pace.

Japan and China are presented as Eastern Asia. China is treated rather thoroly. A discussion of natural environment, population and agricultural economy is followed by a chapter devoted to China's geographic regions for which the author has adopted Cressey's system of subdivisions. Major contrasts between North and South China, so clearly distinguished by Cressey, are not emphasized as much as is desirable for students who use this as a framework for further study. A good analysis of China's minerals, industry and commerce, followed by a chapter which deals with Manchukuo, should help students to analyze the importance of this area in contemporary world affairs.

The treatment of Japan does not seem consistent with that given to China and India. The economic phases of Japan are well treated but the author fails to emphasize regional differentiation. Certainly Japan can be thus divided both in coarse lineaments and fine. A broad general distinction between southern, middle and northern parts of the archipelago as given in Trewartha's "Reconnaissance Geography of Japan" or by Hall in "Agricultural Regions of Asia" at least seems desirable. Other parts of the Japanese Empire including Taiwan, Ryukyu Islands, Chosen and Karafuto are dealt with in this part even tho they are more closely associated with other regions.

The final division is devoted to Northern Asia with a concluding chapter summarizing Asia's trade and future possibilities.

Altho in places there is a feeling of a need for more illustrations, good use has been made of clear and simple diagrams and grafs. Pictures, however, are too few and those used are, on the whole, rather poor and inadequately titled. A large reference map is also lacking.

A useful list of references is given at the end of each chapter but one misses such an excellent source as "Geographie Universelle." Source materials have been carefully used but the encyclopaedic treatment of parts of the book show a lack of field observation.

As a book which professes to treat the economic geography of Asia, the reviewers feel it does well to suggest the environmental setting in which the economic factors operate. However, lack of uniformity in the degree to which this approach is followed gives the impression, where detailed analysis is made, that a regional as well as an economic geography is attempted. Taken as a whole this book is a welcome contribution to the field of geographic teaching. It fulfills a long felt need for a clear and fairly well balanced text on Asia. It is written in clear simple style and, in general, the material is so organized that the book is very teachable. It is the best book on Asia that has yet been published for American students of college level.

University of Wisconsin.

LYLE E. CRAINE
WARNER J. GEIGER

Paul B. Sears. **Deserts on the March.** 231 pp. University of Oklahoma Press, Norman, Oklahoma. 1935. **$2.50**

The "Deserts on the March" are man-made—the desolation which all too commonly results when man disturbs the balance of nature. Altho the title was suggested by the dust storms of recent years, the book goes beyond the problems they present to include a lively, highly stimulating survey of the field of conservation of natural resources, as seen by a plant ecologist. The emphasis, quite naturally, is on plant, water, and soil resources.

The opening chapter, dealing with the destructive exploitation of natural resources, is followed by a sketch of the history of anti-conservational practices in the Far East, North Africa, and Europe. Moving to the United States, the effect of the advance of settlement on the biotic, water, and soil resources is traced for the North, the South, and the West. Chapters follow on conservation of forests and grass lands, the prevention of erosion and the control of floods, the proper use of our waters and their fish life, utilization of dry lands, agricultural adjustments to climate, and the control of pests. In conclusion, attention is directed to the need for inventing devices for rewarding the private individual who practices conservation, and to the part scientists should take, plant ecologists in particular, in formulating programs for regional and state planning. Running thruout the discussion are three basic ideas: that modern man has brought about a positive degeneracy of the natural resources of our country, a degeneracy which promises to be fatal to his own well-being; that nature has marvelous recuperative powers; and that the regeneration of these natural resources will begin as soon as man learns to control himself, and to direct his life more in harmony with his physical environment.

The geographer may wish for a more accurate numbering of Egypt's acres and population, but may well feel a sense of regret that the vivid description of the degeneration of virgin tropical forest into jungle was not written by one of his own clan. If the recognition of the social values attendant on lavish exploitation of natural resources seems inadequate, it should be noted that here is one of the ablest statements of the anti-conservational effects of certain social conditions, tenantry in particular.

The titles of the chapters suggest the light touch of the author, light despite the temptaion to smite with a heavy hand: Man, Maker of Wilderness; Hungry Europe; Poor Richard, Poor Lo; Cold Figures; Leaves of Grass; Mud; Wet Deserts; It Must Be The Weather; Pests; Where is the Sun. If nature is all too clearly personified, the account loses nothing of interest thereby. Perhaps it is inevitable, too, that a book which so thoroly breaks away from the formal style of a scientific text should lack the tedious qualifications which academicians love.

The book is a delight and a challenge, a valuable addition to the deservedly popular literature on conservation of natural resources.

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Among other contributors to this series will be Dr. Ellsworth Huntington of Yale, who will discuss village life; Dr. Eugene Van Cleef, Ohio State University, with an article on Finland and another on Germany; Dr. Loyal Durand, University of Wisconsin, who will discuss life on an estate in Poland; Dr. W. Elmer Ekblaw of Clark University, Norwegian fjord economy and a second article on limitations of steppe agriculture; Dr. Richard Hartshorne of University of Minnesota, will discuss the Polish corridor; Dr. Lester E. Klimm, University of Pennsylvania, will discuss life on Aran Islands; Miss Alice Foster, University of Chicago, an article on Spain; Professor Henry J. Bruman, University of California at Los Angeles, the Bulgarian valley of roses; Mr. E. H. G. Dobby, London, will discuss the Valencia region of Spain; G. Etzel Pearcy, University of Pennsylvania, will discuss the Rhone-Saone valley; Dr. S. Van Valkenburg, Clark University, a paper dealing with the recently reclaimed area of the Zuider Zee; Dr. Carl Stotz, formerly of Robert College, Istanbul, will discuss urban life in southeastern Europe; Dr. Daniel R. Bergsmark, University of Cincinnati, agriculture in Denmark; Mr. E. R. Ackerman, Harvard, a paper on Portugal; Dr. W. O. Blanchard, University of Illinois, a paper on Italy.

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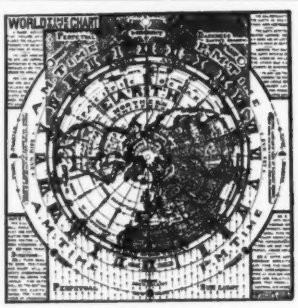

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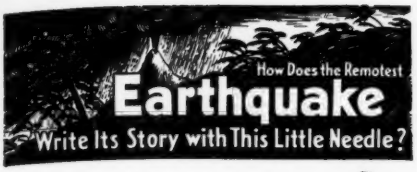

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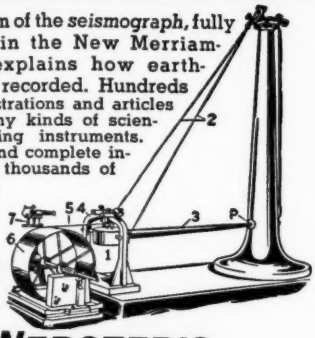

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This treatise covers the historical development of the sugar beet, its distribution, the factors affecting its growth and rotation, the manufacturing processes, markets, tariffs, and labor problems.

1000 and One. **The Blue Book of Non-Theatrical Films.** 144 pp. The Educational Screen, Inc., 64 East Lake Street, Chicago, Illinois. 1935. 75 cents. Eleventh Edition, 1935-36

Floyd F. Cunningham. **Laboratory Manual in the Geography of North America.** Second Edition Revised. 54 pp. Illustrated. John Wiley & Sons, Inc., New York. 1935. $1.25

For college students. Exercises and outline maps to accompany the second edition of the Geography of North America by Miller and Parkins.

Wallace W. Atwood and Helen Goss Thomas. **Workbook in Geography.** To accompany, Nations Beyond the Seas. 96 pp. Illustrated. Ginn & Company, Boston. 1935. 24 cents.

Exercises, outline maps and testing materials.

Fifth Yearbook of the National Council for the Social Studies. Department of Social Studies of National Education Association. Theme: The Historical Approach to Methods of Teaching the Social Studies. 1935. Edited by Edgar Bruce Wesley. McKinley Publishing Company, Philadelphia. 1935

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Mr. Dobby spent two years in field study in the Iberian Peninsula as Travelling Scholar of the University of London. His paper, Agrarian Problems in Spain, appeared in the *Geographical Review* for April, 1936. Other reports based upon his field work, are in preparation. This is the second contribution to our series on Europe.

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Mr. Oliver is an assistant professor of geography, University of North Dakota. He is author of, The North Dakota Weather, in *North Dakota Engineer*, March, 1936 and, The Gothenburg Tornadoes, *Monthly Weather Review*, June, 1931.

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Dr. Durand is an assistant professor of geography at the University of Wisconsin. He has recently contributed, The Forest and Woodland Regions of Wisconsin, to the *Geographical Review*, April, 1935, and, A Farms Area Map of Wisconsin, to the August, 1935 number of the *Journal of Land & Public Utility Economics*. During 1934-1935, Dr. Durand served as Wisconsin Land Planning Consultant to the National Resources Board. In 1925 he contributed an article on, The Grain Trade of the Great Lakes, to the JOURNAL OF GEOGRAPHY.

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Dr. Miller, economic geographer at Los Angeles Junior College, did his undergraduate work at the University of California at Los Angeles and his graduate work at the University of Chicago. During 1934 and 1935 he was associated with the Mississippi Valley Committee and the National Resources Board as a member of the technical staff.

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